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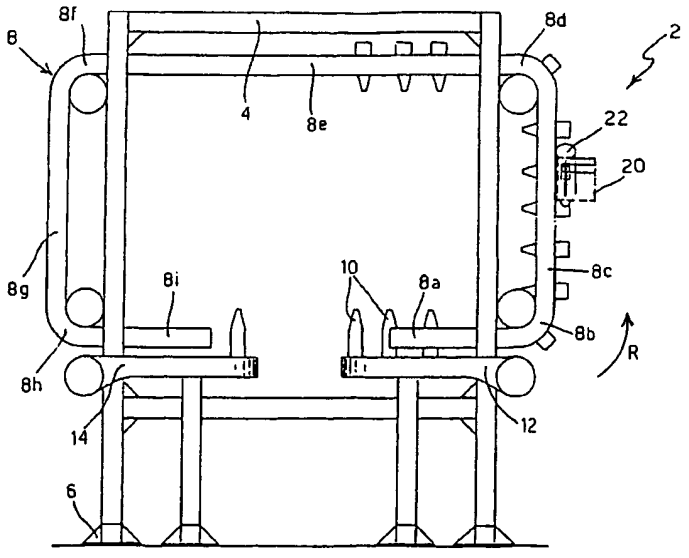
(54) Title: NON-DESTRUCTIVE INSPECTION APPARATUS FOR CONTAINERS OF LIQUID FOODSTUFFS



(57) Abstract: An apparatus for non-destructive inspection of glass containers (10) for liquid foodstuffs, e.g. of bottles, comprising a vertically developing conveyor (8) that: takes the glass containers (10) from an inlet conveyor (12); turns the containers by 90°, conveying them along a vertical section (8c) where they are then exposed to an inspection apparatus (20, 22); and subsequently brings again the containers to a vertical position through a rotation by 270°, depositing the containers on an outlet conveyor (14).

NON-DESTRUCTIVE INSPECTION APPARATUS FOR CONTAINERS OF LIQUID FOODSTUFFS

The present invention relates to a non-destructive inspection apparatus for containers of liquid foodstuffs.

More particularly, the invention relates to an apparatus for X-ray inspection of cylindrical containers, such as bottles and glass pots, of liquid foodstuffs such as wines and other drinks.

It is known that non-destructive X-ray inspection of containers of liquid products is carried out by stationary inspection apparatuses inside which the containers to be inspected are made to pass on a horizontal conveyor belt. Said apparatuses comprise suitable X-ray emitters and detectors, and the relevant control circuits.

Inspection of foodstuff containers aims at detecting the presence of possible contaminants within the container.

Indeed, it is possible that during the working and bottling phases a particle or fragment of a foreign substance, generally of higher specific weight than the liquid where it is by chance present, is found within the container. Since glass bottles are concerned, such a foreign substance could be a glass fragment detached from the container edge, for instance during the corking phase.

It is also known that cylindrical containers such as glass bottles for drinks often have an inwardly curved bottom defining an annular zone with side walls close to each other, which is difficult to be inspected by the X-ray devices. The glass fragment or other contaminant, if any, having a specific weight higher than the liquid inside the container, will fall by gravity on that annulus in the bottle bottom.

Different solutions have been proposed in the past to solve the problem of how to detect the presence of those fragments in a

container with inwardly curved bottom.

A first solution is disclosed in European Patent Application EP 961 114 in the name of the same Applicant.

According to the teaching of the above application, an inspection device is provided comprising a device for transferring the containers or bottles, which upsets the containers about an axis perpendicular to the advance direction, in a plane parallel to the advance direction.

Said device comprises two half-circular curved sections separated by a rectilinear section, along which the X-ray unit is located. The first curved section of the device performs a bottle rotation by 180°, so as to present them upside down through the X-ray unit, whereas the second curved section brings again the bottles to their upright position.

Thus, contaminants that fall by gravity toward the bottle cork during upsetting can be inspected without interference due to the shape of the bottle bottom.

A drawback of the device of the above application is that, when the bottle is upset, the contaminants gather near the cork, in a narrow zone that sometimes is difficult to be inspected.

A second solution is disclosed in Italian Patent Application TO99A001105 in the name of the same Applicant.

That application discloses an apparatus having means for transferring the containers through an X-ray unit. Such means make the container take, while passing through the X-ray unit, a position inclined with respect to a vertical position, while keeping a substantially rectilinear and horizontal advance direction.

The containers are inclined about the advance direction by an angle depending on the shape of the curved bottom of the containers and on the specific weight difference between the contaminants and the liquid inside the container, so as to obtain a

quick displacement of the contaminants towards a region that can be more readily accessed by the X-ray unit, while keeping the container inclination minimum.

Chain conveyors are used as means for transferring the inclined containers through the X-ray unit,

The main inconvenience of such an installation is however its great length, due to the chain conveyors that must be horizontal conveyors. Actually, the containers are to remain inclined for a certain time, necessary in order the contaminants fall onto the bottom, before the containers can be inspected. An installation of such kind can actually be up to 7 to 8 m long.

It is thus an object of the present invention to overcome the above drawbacks, by providing an apparatus allowing a quick and sure inspection of glass containers.

The above and other objects are achieved by an apparatus for non-destructive X-ray inspection of containers of liquid products, such as glass pots or bottles, made according to the invention, as claimed in the appended claims.

The container inspection apparatus made according to the invention conveys the closed and filled bottles along a vertical path, arranges the bottles horizontally in a first section, then makes the bottles pass past the inspection device and, thereafter, upsets the bottles to bring them again to vertical position.

The invention will be now disclosed with reference to the accompanying drawings, relating to a preferred but non limiting embodiment thereof, in which:

- Fig. 1 is a schematic front view of a container inspection apparatus made in accordance with the invention; and
- Fig. 2 is a schematic side view of the apparatus shown in Fig. 1.

Referring to Figs. 1 and 2, an apparatus 2 according to the invention for inspection of containers or bottles comprises a

support structure or frame 4 carrying horizontal inlet and outlet conveyors 12 and 14, respectively, on which the containers or bottles 10 are conveyed in vertical position, and an intermediate conveyor 8 transferring the containers from inlet conveyor 12 to outlet conveyor 14,

Intermediate conveyor 8, of which the displacement direction is shown in Fig. 1 by arrow R, comprises a plurality of curved and rectilinear sections that, in the whole, cause a 360° rotation of the containers, bringing them again to the vertical position at the outlet.

An initial conveyor section 8a seizes containers 10 taking them from inlet conveyor 12, whereas a curved section 8b rotates the containers by 90° and brings them to a horizontal position. Then, containers 10 horizontally run along vertical section 8c, passing through an inspection apparatus 20, 22.

Then the containers are rotated by 90° in curved section 8d, are moved along horizontal section 8e, are again rotated by 90° in curved section 8f, are moved vertically downwards along section 8g and eventually are brought again to the vertical position by sections 8h and 8i. Sections 8d to 8i can be replaced by an equivalent structure, capable of rotating the containers by 270° and of presenting them to the outlet conveyors 14, for instance a single half-circular curved section.

One or several motors, not shown in the drawings, drive in a known manner the different sections of conveyor 8, as well as inlet and outlet conveyors 12, 14.

Inspection apparatus 20, 22 is an X-ray inspection unit, preferably located near the end of vertical section 8c, in any case beyond the half-length thereof. Indeed, in that manner possible contaminants, particles or fragment, present inside the container, have sufficient time to fall by gravity on the container side, even in

case of rather dense liquids.

Inspecting the containers while in horizontal position has the advantage that inspection is not affected by the bottom shape, by the cork or by the container height, as is instead the case for the devices in which the containers are inspected while being in vertical or upset position.

Inspection apparatus 20, 22 comprises a radiation emitter 22, in particular an X-ray emitter, and a radiation detector 20. Detector 20 is connected with an electronic system for automatic display and detection of foreign particles, not shown in the drawing, which is known in se and is normally used in devices of this kind.

Emitter 22 and detector 20 are located, as shown in Fig. 1, so that the axis of the radiation beam emitted by emitter 22 and received by detector 20 is substantially perpendicular to the longitudinal axis of the container being inspected. X rays emitted by emitter 22 therefore laterally run through containers 10, passing through two glass layers of uniform thicknesses.

Moreover, as shown in detail in Fig. 2, radiation emitter 22 and the associated detector 20 are inclined by about 45° relative to the horizontal plane, Thus, while the container is passing, the radiation beam emitted by emitter 22 wholly scans the container side on which contaminants, if any, fall, without hindering in any way the conveyor movement.

The apparatus of the invention thus allows improving performance since the glass thickness in the area to be inspected is reduced. Moreover, in such area, glass thickness is constant and allows inspecting an image with substantially zero gradient.

Patent claims

1. An apparatus (2) for non-destructive inspection of closed containers (10) of liquid foodstuffs, the apparatus comprising a conveyor (8) along which a plurality of said containers (10) is made to advance and which has a horizontal initial section (8a) in which said containers (10) pass while being kept in vertical position, and an inspection apparatus (20, 22) located along the path of said conveyor (8), characterised in that said conveyor (8) includes a first curved section (8b), adapted to rotate by 90° the containers (10) coming from said initial section (8a) and connected to a vertical rectilinear section (8c) in which said containers (10) pass while being kept in horizontal position, and in that said inspection apparatus (20, 22) is located along the path of said vertical rectilinear section (8c).
2. An apparatus according to claim 1, wherein said conveyor (8) further includes a plurality of curved sections (8d, 8f, 8h), adapted to perform an overall rotation by 270° of the containers (10) coming from said vertical section (8c), thereby bringing again the containers to the vertical position on a horizontal end section (8i).
3. An apparatus according to claim 2, wherein said conveyor (8) further includes a plurality of intermediate rectilinear sections (8e, 8g), connected between said curved sections (8d, 8f, 8h) and adapted to space said curved sections so as to bring said horizontal end section (8i) in alignment with said horizontal initial section (8a).
4. An apparatus according to claim 3, further comprising a half-circular inlet conveyor (12), adapted to convey said containers (10) in correspondence of said horizontal initial section (8a) of said conveyor (8), and an outlet conveyor (14), also with half-

circular shape, adapted to take said containers (10) from the horizontal end section (8i) of said conveyor (8).

5. An apparatus according to claim 1, wherein said inspection apparatus (20, 22) comprises a radiation emitter (22) and a radiation detector (20) located near the path of said vertical section (8c), so that the axis of the radiation beam emitted by said emitter (22) and received by said detector (20) is substantially perpendicular to the longitudinal axis of the container being inspected.

6. An apparatus according to claim 5, wherein said radiation emitter (22) and detector (20) are so located that the axis of the radiation beam emitted by said emitter (22) and received by said detector (20) is inclined by about 45° relative to a horizontal plane.

7. An apparatus according to claim 1, wherein said inspection apparatus (20, 22) is located in the end portion of said vertical rectilinear section (8c).

8. An apparatus according to any preceding claim, wherein said radiation consists of X-rays.

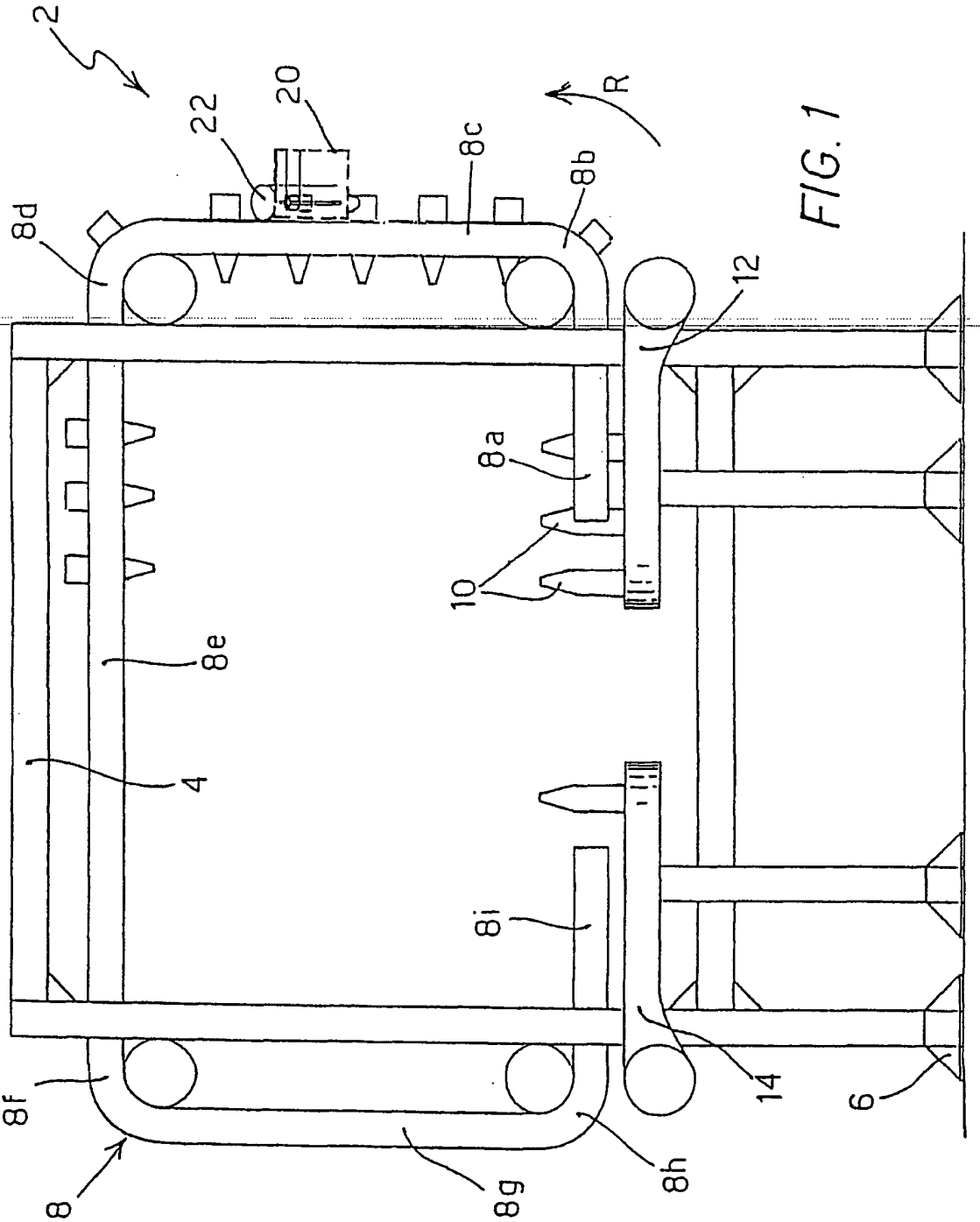


FIG. 1

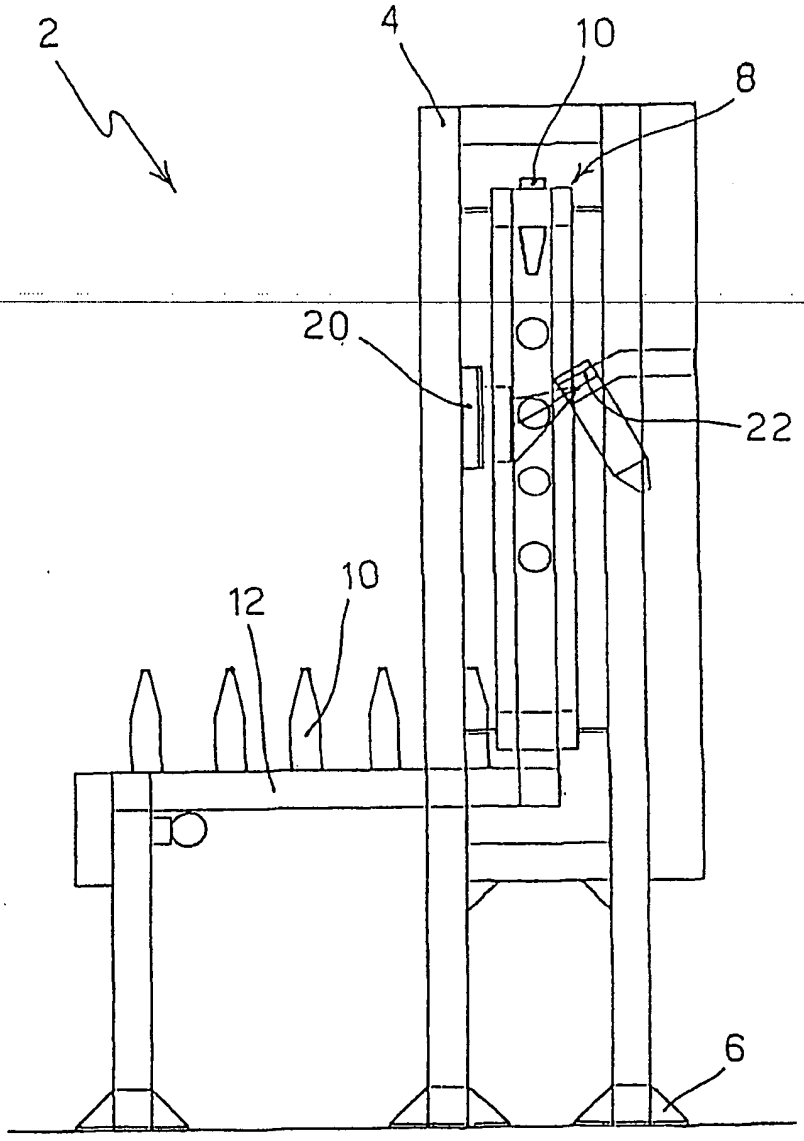


FIG. 2

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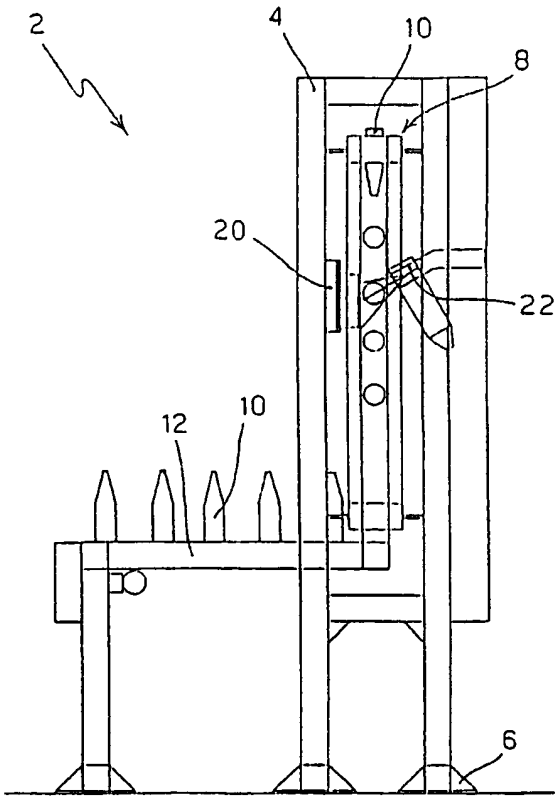

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N23/04 G01N23/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
PAJ, WPI Data, EPO-Internal, INSPEC, COMPENDEX, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 961 114 A (DYLOG ITALIA S P A) 1 December 1999 (1999-12-01) cited in the application claim 1	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
5 March 2002	14/03/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Van den Bulcke, E

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0961114 A	01-12-1999	CN 1236099 A	24-11-1999
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